Randomized Trial

Sphenopalatine Ganglion versus Greater Occipital Nerve Blocks in Treating Post-Dural Puncture Headache after Spinal Anesthesia for Cesarean Section: A Randomized Clinical Trial

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Background: Despite being invasive, with serious complications, epidural blood patch (EBP) is still considered the gold standard therapy for Post Dural Puncture Headache (PDPH). The use of Peripheral nerve blocks for PDPH are studied here.

Objectives: To investigate the efficacy of sphenopalatine ganglion block (SPGB) and greater occipital nerve block (GONB) to relieve PDPH and its associated symptoms.

Study Design: Randomized comparative single-blind trial.

Setting: A University hospital.

Methods: Patients who received spinal anesthesia for elective cesarean section, and then developed PDPH during hospitalization or within 5 days after dural puncture were enrolled to receive GONB (n = 47) or SPGB (n = 46) for treatment of PDPH. GONB Group: Patients received bilateral GONB using 3 mL mixture of 2 mL lidocaine 2% plus 1 mL dexamethasone 4 mg on each side of occipital region. SPGB Group: Patients received bilateral SPGB using the same mixture in each nostril. Assessments included Numeric Rating Scale (NRS) for severity of headache at supine and sitting positions, nausea NRS, neck stiffness, need for EBP, and complications.

Results: The supine and sitting headache NRS scores significantly decreased at 30 minutes after blocks and throughout follow-up period in both groups ($P < 0.000$). Clinically significant drop of NRS to < 4 was reached earlier in GONB group. There was a significant difference between groups after 2 hours in supine and sitting headache NRS scores ($P = 0.020$ and 0.030, respectively); however, both treatments showed similar effectiveness from the third hour afterwards ($P > 0.05$). Both techniques were effective in relieving neck stiffness and nausea ($P < 0.000$), with no adverse effects.

Limitations: A limitation to this study was the small sample size.

Conclusions: GONB and SPGB are equally effective in relieving symptoms of PDPH. Both techniques are safe, simple, and less invasive than EBP.

Key words: Cesarean Section, epidural blood patch greater occipital nerve block, post-dural puncture headache, sphenopalatine ganglion block

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One of the prevalent complications associated with neuraxial anesthesia is post-dural puncture headache (PDPH) (1). The International Headache Society defined PDPH as bilateral headache of uniquely positioned quality, that develops within 7 days and disappears within 14 days after dural puncture (1). Regional anesthesia is the preferred technique (50 - 84%) for elective cesarean sections and the intensity of PDPH in obstetric patients is higher than other categories (2). This headache causes short-term, significant disability, prohibits ambulation or care for the newborn, and leads to

prolonged hospital stay (3). Autologous epidural blood patch (AEBP) has been considered the gold standard treatment modality for PDPH, with 75% success rate (1, 3). However, AEBP is an invasive procedure, with risk of difficulty in determining the epidural space, patient discomfort during the procedure, inadvertent dural puncture, infection, and neurological complications (4).

Sphenopalatine ganglion (SPG) is an extra-cranial neural structure located in the pterygopalatine fossa which contains sympathetic and parasympathetic components in addition to its' somatosensory roots. It can be accessed through transnasal or transcutaneous approach. Sphenopalatine ganglion block (SPGB) has been used clinically to manage migraine, trigeminal neuralgia, cluster headache, and atypical facial pain (5). Transnasal approach is a noninvasive, low risk technique, which can be easily performed at bedside without using imaging tools. It is thought to be useful in treating PDPH by reducing parasympathetic flow to cerebral vessels through blockade of the SPG. This allows cerebral vessels to return to their normal, nondilated state thereby relieving headaches (5).

The greater occipital nerve (sensory fibers from C2 and C3 cranial segments) innervates the medial part of the posterior scalp to the anterior side of the vertex. Greater occipital nerve block (GONB) prevents pain sensation of this region (6). GONB has been reported to provide relief of various headache symptoms, including occipital neuralgia, migraine, and cluster headaches (7). Recent guidelines for PDPH management have been modified and GONB has been included as part of the standard management of PDPH (8).

Corticosteroids (such as dexamethasone, methylprednisolone, and triamcinolone) are powerful anti-inflammatory agents and are used as adjuvants to local anesthetics for peripheral nerve blocks (9). Many investigators administer local anesthetics as the abortive agents that produce quick onset of headache relief, simultaneously administering locally acting steroids to generate a long-lasting preventive effect (up to 6 weeks) (7, 9).

In this study, we aimed to investigate the efficacy of SPGB versus GONB in the treatment of PDPH after cesarean section using lidocaine/dexamethasone combination hypothesizing that both techniques might be safe, noninvasive alternative for EBP.

Methods

Ethical Considerations, Eligibility and Study Design

This randomized, single-blinded clinical trial was conducted in Women's Health Hospital, after obtaining an Institutional Review Board approval from the Medical Ethics Committee, Faculty of Medicine, Assiut University, Egypt (Protocol ID: 17200061 on November 13, 2016). Registration in Clinicaltrials.gov was accomplished before enrollment of the first patient (ID: NCT03156049 on May 17, 2017). This study adheres to the regulations and amendments of Helsinki Declaration and a written informed consent was taken from all patients. Patients were included in the study if they were aged 18 - 40 years; ASA I-II; scheduled for elective singleton, uncomplicated cesarean section under spinal anesthesia (using 25-gauge Quincke spinal needles), then developed PDPH during hospitalization, or within 5 days after the dural puncture. Patients were excluded from the study if there was patient refusal, any contraindication to regional block, local scalp infection, nasal pathology, allergy to local anesthetics, pregnancy-induced hypertension, history of major psychiatric disorders, chronic headache, or current opioid use.

Randomization and Blindness

Using a computer-generated randomization schedule, patients were randomly allocated into 2 groups of 50 patients each.

GONB Group

Patients received bilateral GONB using a mixture of 3 mL of 2 mL lidocaine 2% plus 1 mL dexamethasone 4 mg on each side of the occipital region.

SPGB Group

Patients received bilateral SPGB using a mixture of 3 mL of 2 mL lidocaine 2% plus 1 mL dexamethasone 4 mg in each nostril.

The trial was planned so that neither the anesthesiologist who performed the blocks, nor the patients were blinded to the technique. Only the data collection personnel were blinded to the group assignment.

Study Protocol

All patients included in this study met the International Headache Society criteria for diagnosis of PDPH (10), as follows: 1) headache that: a) worsens within 15 minutes of sitting or standing; b) improves within 15 minutes after lying down; c) must have one of the following associated manifestations of: neck stiffness, tinnitus, hypoacusis, or photophobia; 2) dural puncture

has been performed; 3) headache develops within 5 days after dural puncture; 4) headache relieved either spontaneously within a week (95% of cases) or 48 hours after EBP. Those patients received conservative treatment that consisted of adequate hydration (oral/IV), analgesics (such as NSAIDS, opioid analgesics, nefopam- a centrally acting nonopioid analgesic, or intravenous paracetamol), antiemetics, and caffeine.

Patients whose conservative management failed to control headache and its associated symptoms (neck stiffness, photophobia, nausea, and tinnitus) were given information leaflets about SPGB, GONB, and EBP. Failure of conservative management was defined as headache score > 4/10 on a numerical rating scale (NRS) when the patient assumed an upright position. According to group assignment, patients received either SPGB or GONB. Upon completion of the block, patients were strictly observed up to 1 hour, then transferred to the ward. NRS assessment was recorded before the block (baseline), at 30 minutes; 1, 2, 3, 6, 12, 24, and 48 hours; and 1 week after the block. For patients who were discharged before 48 hours, NRS assessment was recorded through telephone calls. Patients were coached to maintain good hydration and to drink caffeinated beverages. Patients with incomplete relief of headache received 1g intravenous (IV) acetaminophen (Perfalgan, paracetamol 1000 mg, UPSA laboratories, France) for supplemental analgesia and were offered to receive a second block after 24 hours from the first block. If headache returned after the second block and was not tolerable (headache score > 4/10 on NRS score), EBP was recommended and the assigned intervention was considered failed.

Interventions

SPGB

The patient was placed supine with shoulders slightly elevated to flex the neck and extend the head. Then anterior nares were inspected for polyps, tumors, or significant septal deviation. Long cotton-tipped applicators saturated with lidocaine 2% were inserted into each naris, until properly seated in the posterior nasopharynx (Supplemental Fig. 1). These were left in place for 10 minutes to lubricate and anesthetize the mucous membrane, making the procedure more comfortable. Then 3 mL mixture of lidocaine 2% and dexamethasone 4 mg were injected transnasally in the sphenopalatine area (Supplemental Fig.2). The technique was repeated in the other nostril. Then the patient was seated and pain assessments were recorded (11).

GONB

The back of the head was sterilized with an antiseptic solution and the landmarks at the base of the skull were identified while the patient in the prone position. The landmarks were located on the medial third of a line drawn from occipital protuberance to mastoid process (Fig. 3). At this level, the greater occipital nerve lies immediately medial to the occipital artery. The skin was infiltrated with 1-2 mL of lidocaine 2%, using a 25-gauge needle. Then the block was performed in this area with 3 mL mixture of lidocaine 2% and dexamethasone 4 mg to block greater occipital nerve. Then the procedure was repeated on the other side. After the procedure, the presence of bilateral occipital numbness was confirmed after 30 minutes. The patient was then positioned sitting and pain scoring was assessed (12).

EBP

In either study groups, if patient was not responding to the assigned intervention after 24 hours of the block (failed block), lumbar EBP was performed in the theatre by a senior anesthetist, under strict aseptic precautions and standard monitoring. The patient was placed in the lateral decubitus position and the lumbar area was equipped and wrapped. Once the epidural space was located at the level of the previous dural puncture, 15 mL of patient's own venous blood was drawn by a trainee anesthetist from the antecubital vein into a plastic syringe, using a strictly aseptic technique. The blood was injected slowly into the epidural space until the headache resolves or the patient reports discomfort in the back over a course of 30 seconds (13).

Outcome Measurements

The following data were collected:

- 1) patients' demographic and clinical data including age, weight, and height; 2) headache score in the supine as well as sitting position (NRS; 0 = no pain to 10 = the worst pain imaginable), nausea severity score (NRS; 0-10). Scores were recorded before the blocks (baseline), at 30 minutes; 1, 2, 3, 6, 12, 24, and 48 hours; and 1 week after the assigned block, and additionally at 1 and 6 weeks in patients who received EBP. Patients who were discharged home were followed up through telephone calls.
- Neck stiffness (yes/no), photophobia (yes/no), tinnitus (yes/no).

- Period of hospital stay.
- Outcome of the performed blocks: complete relief, incomplete relief, or failure of the block to reduce symptoms.
- Any side effects of the study drugs or the interventions, including bleeding from the scalp, nasal trauma, pain at the injection site, dizziness, vasovagal syncopal attacks, infection, and nerve damage.
- Patient satisfaction: at end of the study, patients were asked to evaluate their satisfaction regarding the received intervention through 5-point Likert scale (1 = very satisfied, 2 = satisfied, 3 = neither satisfied nor dissatisfied, 4 = dissatisfied, 5 = very dissatisfied).

Statistical Analysis

Power of the Study

The primary outcome was the NRS score for headache when the patient assumes an upright position after block performance. Secondary outcomes were nausea severity scores, neck stiffness, the need for EBP, and complications during and after the performance of the SPGB, GONB, and EBP. Using the G-Power calculator 3.1.9.7 (14) for sample size determination, 47 patients were needed for each group based on a priori analysis with Wilcoxon-Mann Whitney U tests for 2 groups at 2 tailed type I error of 0.05, power of 0.8, effect size of 0.6 with an allocation ratio of 1:1. 100 patients were enrolled to compensate for dropouts.

Statistical Tests

Data were collected and processed using SPSS version 20 (SPSS Inc., Chicago, Illinois, USA). Continuous data was checked for normality by visual inspection of histograms and by the Kolmogorov-Smirnov test. Continuous data was presented as mean (± SD) with 95% confidence interval if normally distributed, and as median (and range) if not normally distributed. Categorical data was expressed as number and frequencies (%) and were analyzed with Chi-Squared or Fisher's exact test as appropriate. For normally distributed data, the Student's t-test and paired Student's t-test were used for analysis of independent and paired samples, respectively. For abnormally distributed and ordinal data, the Mann Whitney U-test or Wilcoxon signed rank tests were used for analysis of independent and paired samples, respectively. P value of < 0.05 was the cutoff value for statistical significance.

Results

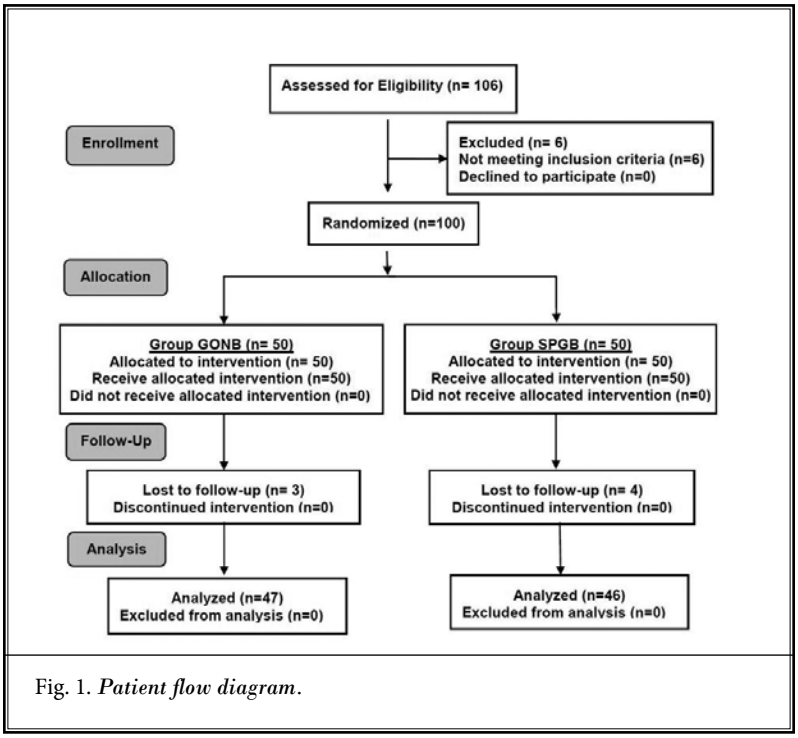

Fig. 1. *Patient flow diagram.*

Patient Flow

Among the 106 women assessed for eligibility, 6 did not meet our selection criteria, and 100 patients (50 in each group) were enrolled in this study. Seven patients were lost during follow-up. Finally, 47 patients in GONB group and 46 patients in SPGB group were subjected to statistical analysis (Fig. 1).

Baseline Data

The patients' demographic and operative characteristics were matched between groups ($P > 0.05$), (Table 1). All patients in this study were of the ASA class I and received intrathecal anesthesia via 25-gauge Quincke needle. No statistically significant differences were recorded between groups in the time of first headache complaint, duration of conservative treatment or the time of first intervention after complaint ($P > 0.05$) (Table 1).

Primary Outcome

The supine headache Numeric Rating Scale (NRS) scores significantly decreased after administration of the block in the 2 studied groups throughout the follow-up period ($P < 0.000$), compared to their respective baseline values. A significant drop in headache score (NRS < 4) was noticed 2 hours after the block in GONB group, versus at 3 hours in the SPGB group. Intergroup comparison showed a significant difference between groups at 2 hours after the block ($P = 0.020$), with no significant differences thereafter (Table 2).

The sitting headache NRS score showed a highly significant decrease after block performance in both groups throughout the follow-up period, compared to their respective baseline values ($P < 0.000$). Intergroup comparison showed a significant difference between groups at 2 hours after the block ($P = 0.030$) with no significant differences at other timepoints (Table 3).

Secondary Outcomes

Figure 2 shows that 39 patients (82.97%), versus 34 (73.91%) patients, complained from neck stiffness in the GONB and SPGB groups, respectively ($P = 0.337$).

Table 1. *Patients' demographic and baseline characteristics.*

Variable	GONB Group (n = 47)	SPGB Group (n = 46)	*P* value
Age (years)	30.9 ± 5.8 (29.2 - 32.7)	31.5 ± 5.8 (29.7 - 33.2)	0.665
BMI (kg/m^2)	26.1 ±2.4 (25.3 - 26.7)	27.1 ± 3.0 (26.2 - 27.1)	0.081
Residence: Rural Urban	20 (42.6%) 27 (57.4%)	17 (37.0%) 29 (63.0%)	0.367
Space of spinal block: L4-L5 L3-L4	34 (72.3%) 13 (27.7%)	37 (80.4%) 9 (19.6%)	0.250
Spinal difficulties: (multiple trials) No Yes	33 (70.2%) 14 (29.8%)	35 (76.1%) 11 (23.9%)	0.343
Time to first headache complaint (hours)	32.9 ± 10.1 (29.9 - 54.0)	33.2 ± 9.2 (30.4 - 54.2)	0.896
Duration of conservative treatment (hours)	19.89 ± 4.9 (13-26)	22.36 ± 2.4 (16 - 27)	0.069
Time of first intervention after complaint (hours)	7.9 ±1.5 (7.0 - 10.0)	8.2 ± 1.1 (6.0 - 9.0)	0.314

Table 2. *Supine headache NRS score.*

Supine headache NRS	GONB Group (n = 47)	SPNB Group (n = 46)	*P* value between groups#
Baseline	6 (5 - 7)	6 (4 - 7)	0.636
After 30 minutes	5 (4 - 6) *P** < 0.000	6 (2 - 7) *P** < 0.000	0.209
After 1 hour	4 (3 - 5) *P** < 0.000	5 (2-7) *P** < 0.000	0.278
After 2 hours	3 (2 - 5) *P** < 0.000	4 (0 - 6) *P** < 0.000	0.020
After 3 hours	2 (1 - 5) *P** < 0.000	2 (0 - 6) *P** < 0.000	0.755
After 6 hours	1 (0 - 6) *P** < 0.000	1 (0 - 6) *P** < 0.000	0.369
After 12 hours	0 (0 - 2) *P** < 0.000	0 (0 - 1) *P** < 0.000	0.439
After 24 hours	0 (0 - 2) *P** < 0.000	0 (0 - 0) *P** < 0.000	0.327
After 48 hours	0 (0 - 2) *P** < 0.000	0 (0-0) *P** < 0.000	0.875
After 1 week	0 (0 - 1) *P** < 0.000	0 (0 - 0) *P** < 0.000	0.578

Data are presented as median (range). *P* value is significant if < 0.05.
#Mann Whitney U-test (between groups).
*Wilcoxon Signed Rank test (*P* value compared to the baseline value inside each group).

Table 3. *Sitting headache NRS score.*

Sitting headache NRS	GONB Group "n = 47"	SPNB Group "n = 46"	*P* value between groups#
Baseline	7 (6 - 8)	7 (6 - 8)	0.173
After 30 minutes	6 (5 - 7) *P** < 0.000	7 (4 - 8) *P** < 0.000	0.161
After 1 hour	5 (4 - 6) *P** < 0.000	5(2 - 7) *P** < 0.000	0.144
After 2 hours	4 (3 - 5) *P** < 0.000	5 (1 - 6) *P** < 0.000	0.030
After 3 hours	3 (1 - 5) *P** < 0.000	3 (0 - 6) *P** < 0.000	0.455
After 6 hours	2 (0 - 5) *P**< 0.000	2 (0 - 6) *P** < 0.000	0.546
After 12 hours	1 (0 - 3) *P** < 0.000	0.5(0 - 6) *P** < 0.000	0.367
After 24 hours	0 (0 - 3) *P** < 0.000	0 (0 - 3) *P** < 0.000	0.684
After 48 hours	0 (0 - 2) *P** < 0.000	0 (0 - 2) *P** < 0.000	0.345
After 1 week	0 (0 - 2) *P** < 0.000	0 (0 - 2) *P** < 0.000	0.323

Data are presented as median (range). *P* value is significant if < 0.05.
#Mann Whitney U-test (between groups).
*Wilcoxon signed rank test (*P* value compared to the baseline value inside each group).

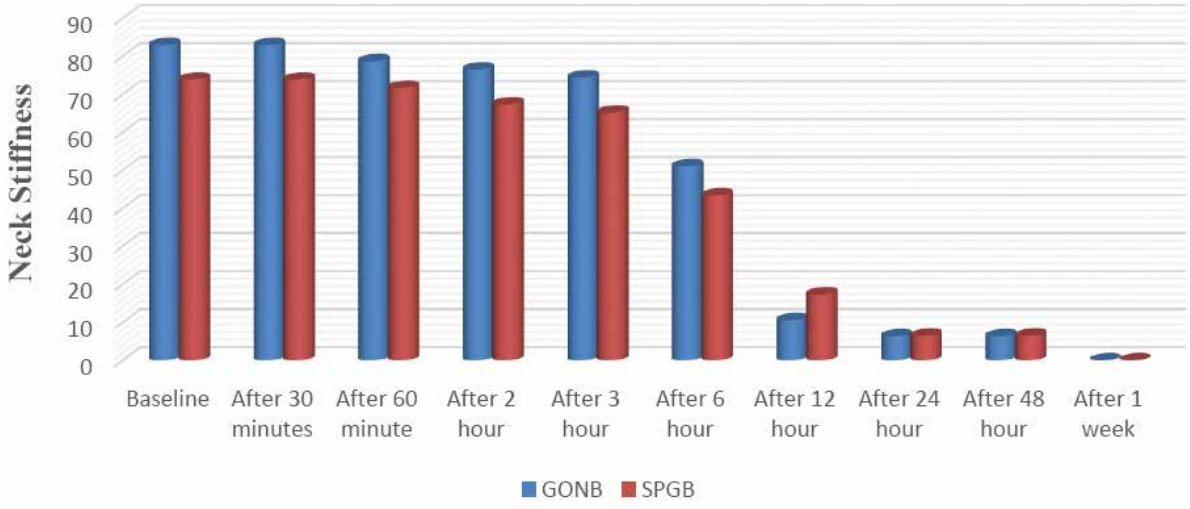

Fig. 2. *Neck stiffness in the two studied groups.*

A significant decrease in the frequency of neck stiffness was recorded at 6 hours after administration of the block in GONB group (24 patients, $P < 0.04$) and in the SPGB group (20 patients, $P < 0.01$), compared with their respective baseline values. Both techniques were equally effective in relieving neck stiffness, with no significant difference between groups at any time point throughout the follow-up period. By the end of the first week, 0 patients in the study were still complaining of neck stiffness.

A highly significant decrease in the nausea NRS score was recorded 2 hours after administration of the block in GONB group ($P < 0.001$) and in SPGB group ($P < 0.002$), compared with their respective baseline values. Both techniques were equally effective in relieving nausea, with no statistically significant difference between groups at any time point throughout the follow-up period (Table 4).

Twenty-seven patients, versus 32, showed complete relief from PDPH and its associated symptoms, in the GONB and SPGB groups, respectively ($P = 0.479$). Patients with incomplete relief were managed with IV analgesics, which was sufficient, and did not request for a second block. Failure of the technique was recorded in 7, versus 5, patients in the GONB and SPGB groups respectively, with those patients then receiving an EBP (Table 5). The mean dose of paracetamol analgesia consumed in GONB group was 1.00 ± 0.00 versus 2.87 ± 0.18 gm in the SPGB group ($P < 0.0001$). There was no statistically significant difference between groups in the duration of hospital stay ($P = 0.646$).

Both techniques gained the same satisfaction level from our study participants on Likert Scale (P P = 0.643). No statistically significant differences were recorded between groups in the prevalence of adverse effects ($P > 0.05$). All patients recovered from those complications within 1 week after treatment and no patients had serious or permanent complications from the administered interventions (Table 5).

Discussion

In this study, the GONB and SPGB significantly relieved PDPH and its associated symptoms. This improvement was evident at 30 minutes after administration of the block in both groups. Clinically significant drop of NRS for headache to < 4 was reached earlier in the GONB group; however, both treatments showed similar effectiveness from the third hour onwards. All patients in this study were free from headache and its associated symptoms 1 week after the block.

Pregnant women who received spinal anesthesia for caesarean section and developed PDPH were our candidates for this study. This is because PDPH is more frequently noted in pregnant women receiving neuraxial anesthesia (1). Obstetric patients are at greater risk because of gender, predisposition, younger age, and greater exposure to neuraxial techniques (15). Additionally, the intensity of PDPH in obstetric patients is reported to be significantly higher when compared with other patients' categories (16).

The mean age of presentation of our participants was 30.9 ± 5.8 years in GONB group and 31.5 ± 5.8 years

Table 4. *Nausea NRS score.*

Nausea NRS	GONB Group (n = 47)	SPNB Group (n = 46)	*P* value between groups#
Baseline	4(1 - 4)	4(0 - 4)	0.075
After 30 minutes	4 (2 - 4) *P** = 0.437	3 (0 - 4) *P** = 0.237	0.054
After 1 hour	3 (2 - 4) *P** = 0.294	3 (0 - 4) *P** = 0.537	0.644
After 2 hours	2 (2 - 3) *P** < 0.001	2 (0 - 4) *P** < 0.002	0.488
After 3 hours	2 (1 - 2) *P** < 0.002	2 (0 - 3) *P** < 0.002	0.161
After 6 hours	1 (1 - 2) *P** < 0.000	1 (0 - 3) *P** < 0.000	0.106
After 12 hours	1 (1 - 1) *P** < 0.000	1 (0 - 3) *P** < 0.000	0.287
After 24 hours	1 (1 - 1) *P** < 0.000	1 (0 - 3) *P** < 0.000	0.287
After 48 hours	1 (1 - 1) *P** < 0.000	1 (0 - 3) *P** < 0.000	0.127
After 1 week	1 (1 - 1) *P** < 0.000	1 (0 - 2) *P** < 0.000	0.320

Data are presented as median (range). *P* value is significant if < 0.05.
#Mann Whitney U-test (between groups).
*Wilcoxon signed rank test (*P* value compared to the baseline value inside each group).

Table 5. *Treatment outcomes, Likert score and Adverse effects.*

Item	GONB Group (n = 47)	SPGB Group (n = 46)	*P* value
Treatment outcome: Complete relief Incomplete relief Failure	27 (57.44%) 13 (27.65%) 7 (14.59%)	32 (69.56%) 9 (19.56%) 5 (10.86%)	0.479
Total consumption of IV paracetamol rescue analgesia after blocks (gram)	1.00 ± 0.00	2.87 ± 0.18	0.0001
Hospital stay (days)	2 (2.0 - 5.0)	2 (1.0 - 5.0)	0.646
Likert score:			
Very satisfied	23 (48.9%)	29 (63.0%)	0.643
Satisfied	4 (8.5%)	3 (6.5%)	
Neither satisfied nor dissatisfied	5 (10.6%)	2 (4.3%)	
Dissatisfied	8 (17.0%)	7 (15.2%)	
Very dissatisfied	7 (14.9%)	5 (10.9%)	
Complications and adverse effects:			
Photophobia	2 (4.25%)	4 (8.69%)	NA
Tinnitus	2 (4.25%)	3 (6.52%)	NA
Vasovagal syncopal attacks	1 (2.12%)	2 (4.34%)	NA
Pain at site of injection	14 (29.78%)	12 (26.1%)	0.573
Dizziness	3 (6.38%)	7 (15.21%)	0.180

Data are presented as mean (±SD), number of patients (percentages), and median (range). NA; not applicable. *P* value is significant if < 0.05.

in SPGB group. Similarly, previous studies described the range of maternal age between 29 to 31years (7, 17, 18).

The BMI was 26.1 ± 2.4 kg/m^2 in GONB group versus 27.1 ± 3.8 kg/m^2 in SPGB group. A similar pattern of results was obtained in a previous study (7). The observed opposite correlation between PDPH and BMI might be explained in this way: the increase in epidural pressure observed in obese, compared with lean, individuals may decrease the pressure gradient from the intrathecal to the epidural space, resulting in less cerebral spinal fluid (CSF) leak through a dural rent and a lower incidence of PDPH. Increased intra-abdominal pressure may reduce nonCSF volume in the epidural space (19).

The important factor contributing to the increased incidence of PDPH was the size and type of used needles (20). The thicker the needle and the more traumatic the needle type (cutting needles), the higher the incidence of headache after spinal anesthesia. A pattern similar to our results was obtained in another research study, where smaller gauge Quincke spinal needles have a distinct advantage over larger gauge Quincke spinal needles, in terms of frequency and severity of PDPH (20).

No statistically significant difference was recorded between the 2 study groups regarding the duration of conservative treatment, time to first headache complaint, or time of first intervention after complaining. These results are consistent with Zorrilla-Vaca and Makkar, who found that PDPH typically occurs within 48 hours after dural puncture (21).

The statistical intragroup analysis of the headache NRS score (supine and sitting position) at different times showed a significant improvement in NRS scores in both groups throughout the follow-up period. Both techniques were equally effective in relieving headache; whereas patients in the GONB group reached a significantly lower NRS scores for headache at supine position and sitting position earlier, compared to patients in the SPGB group. This result is in line with some investigators who found the same results after GONB (22).

Urits and colleagues published their experience with 13 patients, with moderate to severe PDPH, subjected to bilateral SPGB for symptom resolution. Good pain relief was recorded in 11 patients, while the remaining 2 required EBP (23). Bilateral SPGB was successfully used in patients with PDPH, despite the small number of patients presented to this block (24). Our findings are consistent with a recent study on the block effectiveness in treating spinal headache. The authors recorded that when matching the time taken to obtain the clinical effects, SPGB provided a faster and more comfortable pain relief than conservative procedures (25). Other physicians have published their experience with 3 patients diagnosed with PDPH, who subsequently underwent intranasal SPGB. All 3 patients had good pain relief and none required a rescue EBP (26).

Akin Takmaz et al (27), described a case with PDPH, which did not respond to conservative treatment and was resolved within 2 minutes after GONB using bupivacaine. After 12 hours of the block, they reported mild pain not restricting activities of daily living. The block was repeated until the pain completely resolved. Naja, et al (28), compared the effect of bilateral GONB on the PDPH with conventional measures and described that the pain fades completely with 1 or 2 injections in 68% of patients, while the remaining 32% required 3 or 4 injections.

In this study, both GONB and SPGB dramatically improved the associated symptoms of PDPH, namely neck stiffness and nausea. Similar results were recorded by Cohen et al (29) and Xavier et al (30) who reported that patients showed significant comfort from PDPH and its' associated symptoms at 30 and 60 minutes after treatment with SPGB.

Total analgesic consumption (gram) was higher in SPGB group, than in GONB group. A possible explanation for the use of more analgesia in SPGB is, that when there is a CSF leak, this ganglion is stimulated and causes cerebrovascular vasodilation by releasing acetylcholine, nitric oxide, and vasoactive intestinal peptide inside the dural blood vessels. Releasing these chemicals may also increase the plasma protein leakage and cause neuritis, leading to triggering trigeminal nociceptors and contributing to pain and headache that lead to increased analgesic consumption (31). Intranasal administration of lidocaine 2% anesthetizes the SPG and deceases signaling, which relieves the PDPH. What remains unclear is the mechanism of action of short acting agents, such as lidocaine to provide ongoing relief of symptoms of PDPH beyond the duration of action of the drug. This block seems to have a comparable prolonged effect in the therapy of migraines (32).

In addition, the observed increase of analgesic dose in SPGB patients, compared to GONB patients, can be attributed to the fact that GONB is a regional anesthesia technique. A possible mechanism of action of prolonged analgesia with GONB may be related to a central neuromodulatory effect from the block, resulting in decreased central sensitization as a result of the temporary reduction in afferent input to the dorsal roots and trigeminal nucleus (33).

Limitations

We performed this study in a narrowly defined cohort of patients. Further studies with larger sample size of both genders may be needed to validate our results. Also, even though GONB is an easily performed procedure when using an anatomic, palpation guided technique, ultrasound guidance would likely have decreased the failure rate of the block in our study.

Conclusions

Both the GONB and SPGB were equally effective in relieving the PDPH and its' associated symptoms. Both techniques are safe, easily performed, and less invasive than EBP, without any serious adverse effects. Further randomized clinical studies are needed to confirm these results, so that GONB or SPGB can be recommended as a first line treatment for PDPH.

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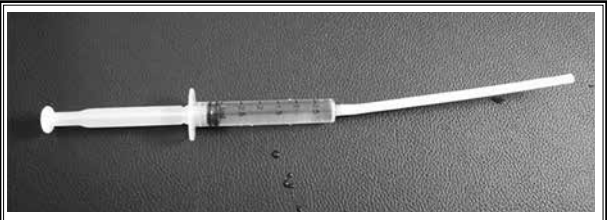
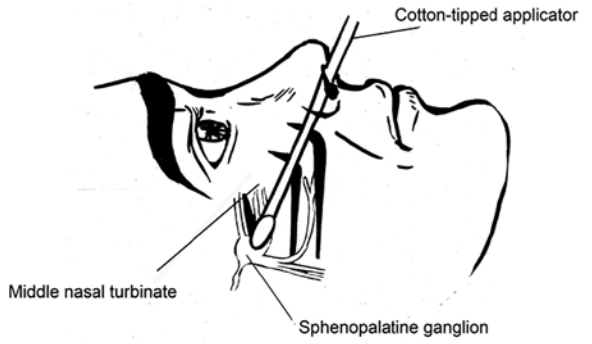
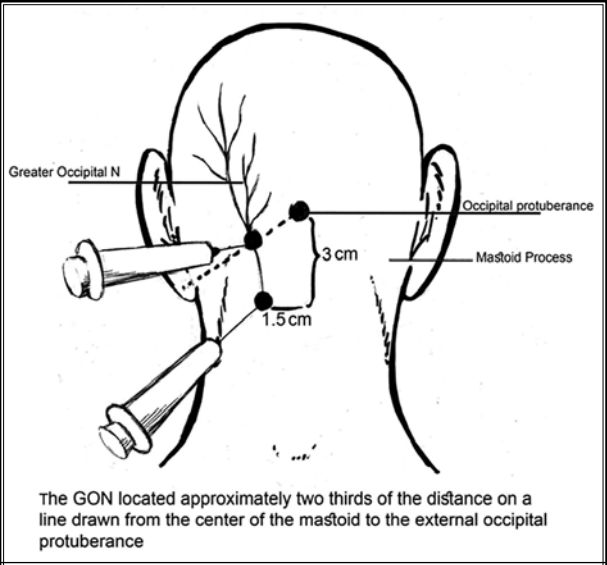


Supplemental Fig. 1. *Device used for sphenopalatine ganglion block (SPGN).*



Supplemental Fig. 2. *Schematic diagram for sphenopalatine ganglion block (SPGN)*



Supplemental Fig. 3. *Schematic diagram for greater occipital nerve block (GONB)*
Video record describing the technique of sphenopalatine ganglion block (SPGN).